

64K x 32, 64Kx36
SYNCHRONOUS FLOW-THROUGH
STATIC RAM

FEBRUARY 2004

FEATURES

- Internal self-timed write cycle
- Individual Byte Write Control and Global Write
- Clock controlled, registered address, data and control
- Interleaved or linear burst sequence control using MODE input
- Three chip enables for simple depth expansion and address pipelining
- Common data inputs and data outputs
- Power-down control by ZZ input
- JEDEC 100-Pin TQFP package
- Power Supply:
 - +3.3V V_{DD}
 - +3.3V or 2.5V V_{DDQ}
- Control pins mode upon power-up:
 - MODE in interleave burst mode
 - ZZ in normal operation mode
- Industrial Temperature Available: (-40°C to +85°C)
- Automotive Temperature offerings:
 - Option A2: -40°C to +105°C
 - Option A3: -40°C to +125°C

DESCRIPTION

The *ISSI* IS64LF6432, IS64LF6436, IS61LF6432A, and IS61LF6436A are high-speed, low-power synchronous static RAM designed to provide a burstable, high-performance, memory. IS64LF6432 and IS61LF6432A are organized as 65,536 words by 32 bits. IS64LF6436 and IS61LF6436A are organized as 65,536 words by 36 bits. They are fabricated with *ISSI*'s advanced CMOS technology. The device integrates a 2-bit burst counter, high-speed SRAM core, and high-drive capability outputs into a single monolithic circuit. All synchronous inputs pass through registers controlled by a positive-edge-triggered single clock input.

Write cycles are internally self-timed and are initiated by the rising edge of the clock input. Write cycles can be from one to four bytes wide as controlled by the write control inputs.

Separate byte enables allow individual bytes to be written. BW1 controls DQ1-DQ8, BW2 controls DQ9-DQ16, BW3 controls DQ17-DQ24, BW4 controls DQ25-DQ32, conditioned by $\overline{BWE}$ being LOW. A LOW on $\overline{GW}$ input would cause all bytes to be written.

Bursts can be initiated with either $\overline{ADSP}$ (Address Status Processor) or $\overline{ADSC}$ (Address Status Cache Controller) input pins. Subsequent burst addresses can be generated internally by the IS61LF6432A/36A and IS64LF6432/36, and controlled by the $\overline{ADV}$ (burst address advance) input pin.

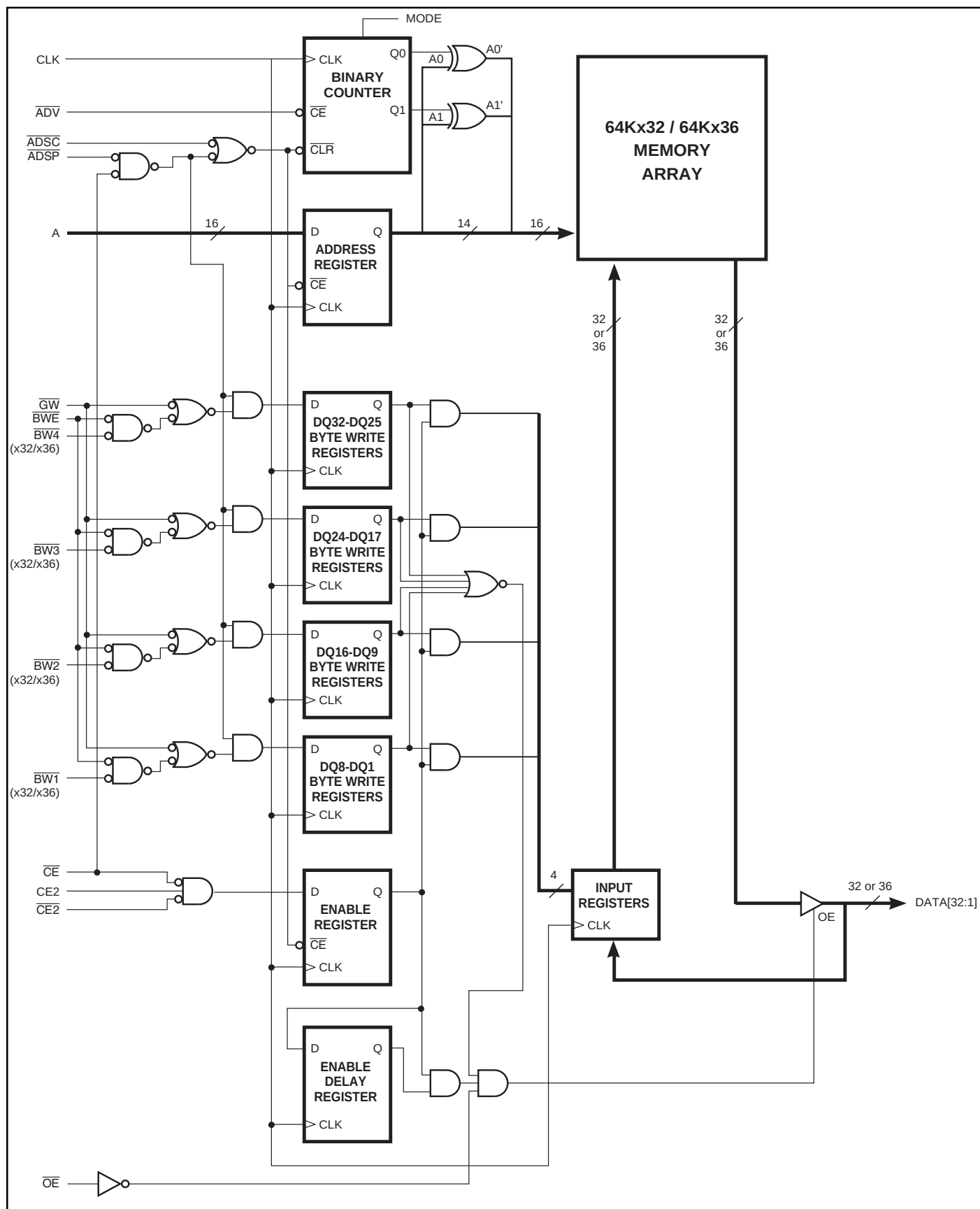
The mode pin is used to select the burst sequence order. Linear burst is achieved when this pin is tied LOW. Interleave burst is achieved when this pin is tied HIGH or left floating.

FAST ACCESS TIME

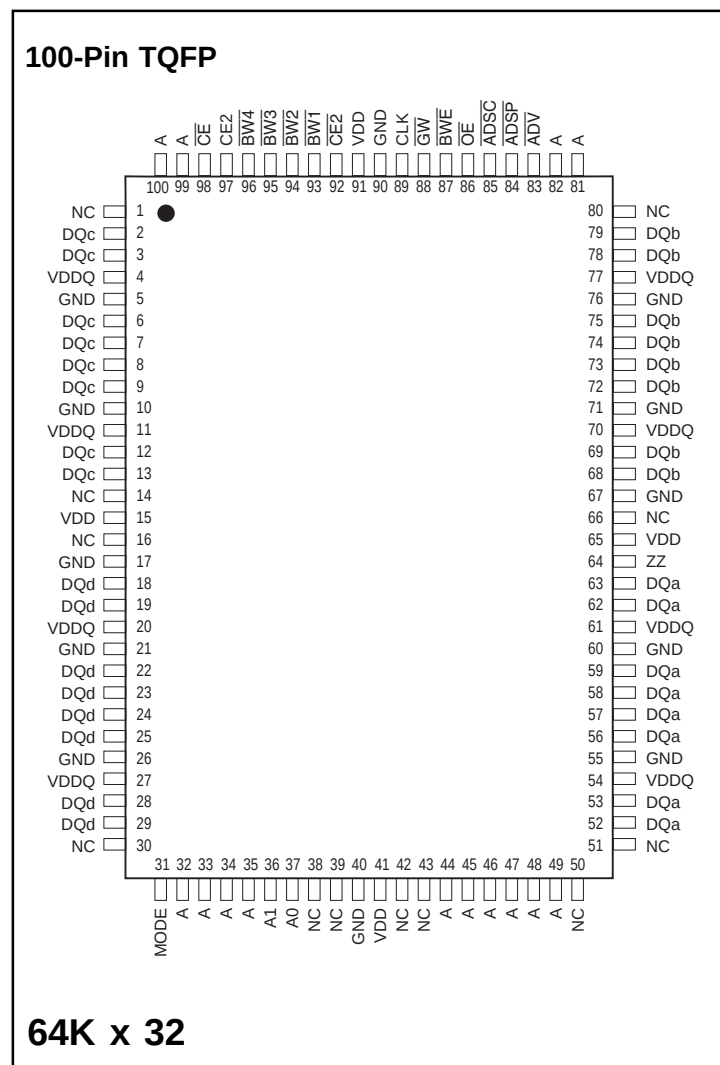
Symbol	Parameter	8.5	10	Unit
t _{KQ}	Clock Access Time	8.5	10	ns
t _{KC}	Cycle Time	11	15	ns
	Frequency	90	66	MHz

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BLOCK DIAGRAM



PIN CONFIGURATION

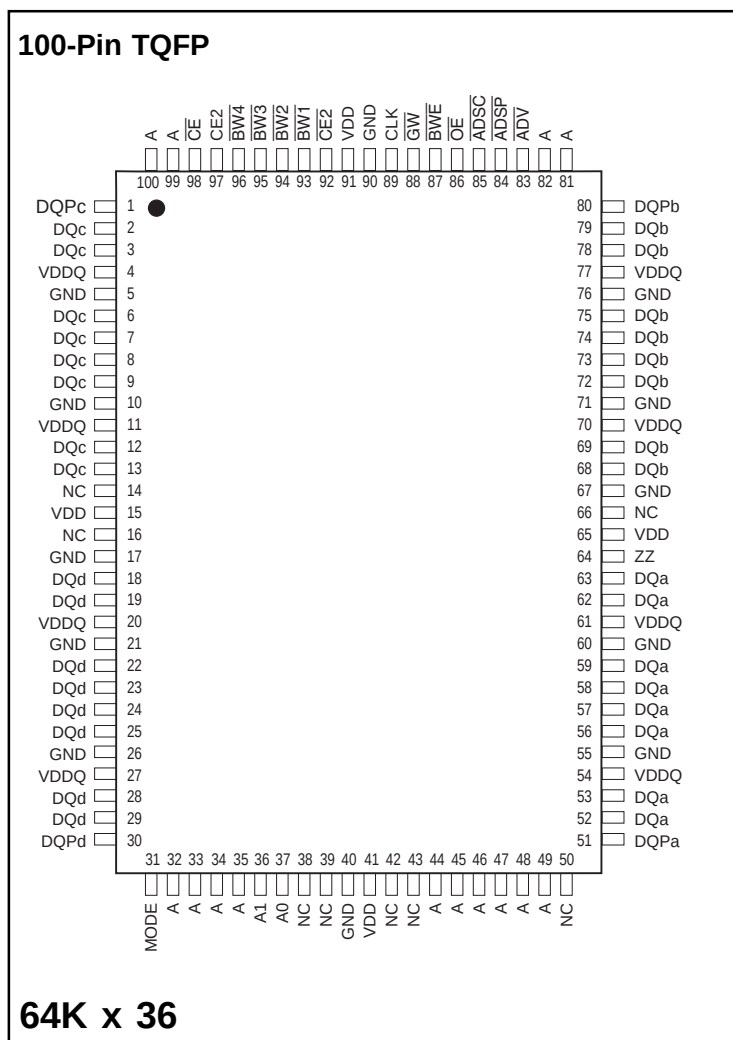


PIN DESCRIPTIONS

A0, A1	Synchronous Address Inputs. These pins must tied to the two LSBs of the address bus.
A	Synchronous Address Inputs
CLK	Synchronous Clock
$\overline{ADSP}$	Synchronous Processor Address Status
$\overline{ADSC}$	Synchronous Controller Address Status
$\overline{ADV}$	Synchronous Burst Address Advance
$\overline{BW1}$ - $\overline{BW4}$	Individual Byte Write Enable
$\overline{BWE}$	Synchronous Byte Write Enable

$\overline{GW}$	Synchronous Global Write Enable
$\overline{CE}$, $\overline{CE2}$, $\overline{CE2}$	Synchronous Chip Enable
$\overline{OE}$	Output Enable
DQa-DQd	Synchronous Data Input/Output
MODE	Burst Sequence Mode Selection
V _{DD}	+3.3V Power Supply
GND	Ground
V _{DDQ}	Isolated Output Buffer Supply: +3.3V or 2.5V
ZZ	Snooze Enable

PIN CONFIGURATION



PIN DESCRIPTIONS

A0, A1	Synchronous Address Inputs. These pins must tied to the two LSBs of the address bus.
A	Synchronous Address Inputs
CLK	Synchronous Clock
$\overline{ADSP}$	Synchronous Processor Address Status
$\overline{ADSC}$	Synchronous Controller Address Status
$\overline{ADV}$	Synchronous Burst Address Advance
BW1-BW4	Individual Byte Write Enable
$\overline{BWE}$	Synchronous Byte Write Enable

$\overline{GW}$	Synchronous Global Write Enable
$\overline{CE}$, $\overline{CE2}$, CE2	Synchronous Chip Enable
$\overline{OE}$	Output Enable
DQa-DQd	Synchronous Data Input/Output
MODE	Burst Sequence Mode Selection
VDD	+3.3V Power Supply
GND	Ground
VDDQ	Isolated Output Buffer Supply: +3.3V or 2.5V
ZZ	Snooze Enable
DQPa-DQPd	Parity Data I/O

TRUTH TABLE

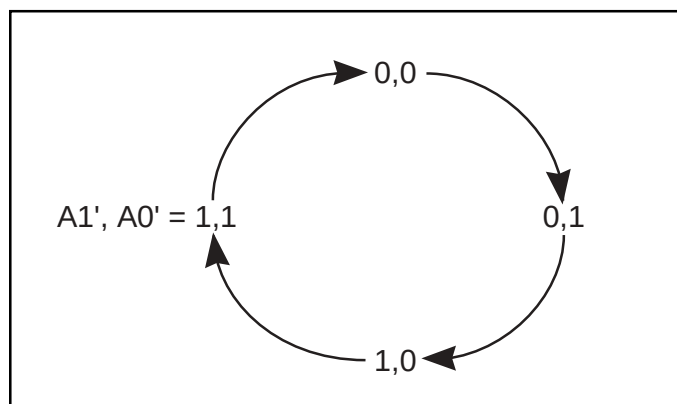
Operation	Address Used	$\overline{CE}$	CE2	$\overline{CE2}$	$\overline{ADSP}$	$\overline{ADSC}$	$\overline{ADV}$	$\overline{WRITE}$	$\overline{OE}$	DQ
Deselected, Power-down	None	H	X	X	X	L	X	X	X	High-Z
Deselected, Power-down	None	L	X	H	L	X	X	X	X	High-Z
Deselected, Power-down	None	L	L	X	L	X	X	X	X	High-Z
Deselected, Power-down	None	X	X	H	H	L	X	X	X	High-Z
Deselected, Power-down	None	X	L	X	H	L	X	X	X	High-Z
Read Cycle, Begin Burst	External	L	H	L	L	X	X	X	X	Q
Read Cycle, Begin Burst	External	L	H	L	H	L	X	Read	X	Q
Write Cycle, Begin Burst	External	L	H	L	H	L	X	Write	X	D
Read Cycle, Continue Burst	Next	X	X	X	H	H	L	Read	L	Q
Read Cycle, Continue Burst	Next	X	X	X	H	H	L	Read	H	High-Z
Read Cycle, Continue Burst	Next	H	X	X	X	H	L	Read	L	Q
Read Cycle, Continue Burst	Next	H	X	X	X	H	L	Read	H	High-Z
Write Cycle, Continue Burst	Next	X	X	X	H	H	L	Write	X	D
Write Cycle, Continue Burst	Next	H	X	X	X	H	L	Write	X	D
Read Cycle, Suspend Burst	Current	X	X	X	H	H	H	Read	L	Q
Read Cycle, Suspend Burst	Current	X	X	X	H	H	H	Read	H	High-Z
Read Cycle, Suspend Burst	Current	H	X	X	X	H	H	Read	L	Q
Read Cycle, Suspend Burst	Current	H	X	X	X	H	H	Read	H	High-Z
Write Cycle, Suspend Burst	Current	X	X	X	H	H	H	Write	X	D
Write Cycle, Suspend Burst	Current	H	X	X	X	H	H	Write	X	D

PARTIAL TRUTH TABLE

Function	$\overline{GW}$	$\overline{BWE}$	$\overline{BW1}$	$\overline{BW2}$	$\overline{BW3}$	$\overline{BW4}$
Read	H	H	X	X	X	X
Read	H	L	H	H	H	H
Write Byte 1	H	L	L	H	H	H
Write All Bytes	H	L	L	L	L	L
Write All Bytes	L	X	X	X	X	X

INTERLEAVED BURST ADDRESS TABLE (MODE = V_{DD} or No Connect)

External Address A1 A0	1st Burst Address A1 A0	2nd Burst Address A1 A0	3rd Burst Address A1 A0
00	01	10	11
01	00	11	10
10	11	00	01
11	10	01	00



ABSOLUTE MAXIMUM RATINGS⁽¹⁾

Symbol	Parameter	Value	Unit
T _{STG}	Storage Temperature	−55 to +150	°C
P _D	Power Dissipation	1.6	W
I _{OUT}	Output Current (per I/O)	100	mA
V _{IN} , V _{OUT}	Voltage Relative to GND for I/O Pins	−0.5 to V _{DDQ} + 0.3	V
V _{IN}	Voltage Relative to GND for for Address and Control Inputs	−0.5 to V _{DD} + 0.5	V
V _{DD}	Voltage on V _{DD} Supply Relative to GND	−0.5 to 4.6	V

Notes:

1. Stress greater than those listed under ABSOLUTE MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.
2. This device contains circuitry to protect the inputs against damage due to high static voltages or electric fields; however, precautions may be taken to avoid application of any voltage higher than maximum rated voltages to this high-impedance circuit.
3. This device contains circuitry that will ensure the output devices are in High-Z at power up.

OPERATING RANGE (IS61LF6432A, IS61LF6436A)

Range	Ambient Temperature	V _{DD}	3.3V (I/O) V _{DDQ}	2.5V (I/O) V _{DDQ}
Industrial	−40°C to +85°C	3.3V, +10%, −5%	3.3V, +10%, −5%	2.5V ± 5%

OPERATING RANGE (IS64LF6432, IS64LF6436)

Option	Ambient Temperature	V _{DD}	3.3V (I/O) V _{DDQ}	2.5V (I/O) V _{DDQ}
A2	−40°C to +105°C	3.3V, +10%, −5%	3.3V, +10%, −5%	2.5V ± 5%
A3	−40°C to +125°C	3.3V, +10%, −5%	3.3V, +10%, −5%	2.5V ± 5%

DC ELECTRICAL CHARACTERISTICS⁽¹⁾ (Over Operating Range)

Symbol	Parameter	Test Conditions	2.5V (I/O)		3.3V (I/O)		Unit
			Min.	Max.	Min.	Max.	
V _{OH}	Output HIGH Voltage	I _{OH} = −4.0 mA (3.3V) I _{OH} = 1.0 mA (2.5V)	2.0	—	2.4	—	V
V _{OL}	Output LOW Voltage	I _{OL} = 8.0 mA (3.3V) I _{OL} = 1.0 mA (2.5V)	—	0.4	—	0.4	V
V _{IH}	Input HIGH Voltage		1.7	V _{DD} + 0.3	2.0	V _{DD} + 0.3	V
V _{IL}	Input LOW Voltage		−0.3	0.7	−0.3	0.8	V
I _{LI}	Input Leakage Current	GND ≤ V _{IN} ≤ V _{DD}	−5	5	−5	5	μA
I _{LO}	Output Leakage Current	GND ≤ V _{OUT} ≤ V _{DDQ} , OE = V _I	−5	5	−5	5	μA

POWER SUPPLY CHARACTERISTICS (Over Operating Range)

Symbol	Parameter	Test Conditions		8.5	10	Unit
				Max.	Max.	
I _{CC}	AC Operating Supply Current	Device Selected,	IND.	180	—	mA
		All Inputs = V _{IL} or V _{IH}	A2	190	—	mA
		OE = V _{IH} , V _{DD} = Max.	A3	—	190	mA
		Cycle Time ≥ t _{KC} min.				
I _{SB}	Standby Current	Device Deselected,	IND.	70	—	mA
		V _{DD} = Max.,	A2	80	—	mA
		All Inputs = V _{IH} or V _{IL}	A3	—	90	mA
		CLK Cycle Time ≥ t _{KC} min.				
I _{ZZ}	Power-down Mode Current	ZZ = V _{DD}	IND.	15	—	mA
		Clock Running	A2	20	—	mA
		All Inputs ≤ GND + 0.2V	A3	—	30	mA
		or ≥ V _{DD} − 0.2V				

Notes:

- The MODE pin has an internal pullup. This pin may be a No Connect, tied to GND, or tied to V_{DD}.
- The MODE pin should be tied to V_{DD} or GND. It exhibits ±10 μA maximum leakage current when tied to ≤ GND + 0.2V or ≥ V_{DD} − 0.2V.

CAPACITANCE^(1,2)

Symbol	Parameter	Conditions	Max.	Unit
C _{IN}	Input Capacitance	V _{IN} = 0V	6	pF
C _{OUT}	Input/Output Capacitance	V _{OUT} = 0V	8	pF

Notes:

1. Tested initially and after any design or process changes that may affect these parameters.
2. Test conditions: T_A = 25°C, f = 1 MHz, V_{DD} = 3.3V.

3.3V I/O AC TEST CONDITIONS

Parameter	Unit
Input Pulse Level	0V to 3.0V
Input Rise and Fall Times	1.5 ns
Input and Output Timing and Reference Level	1.5V
Output Load	See Figures 1 and 2

3.3V I/O OUTPUT LOAD EQUIVALENT

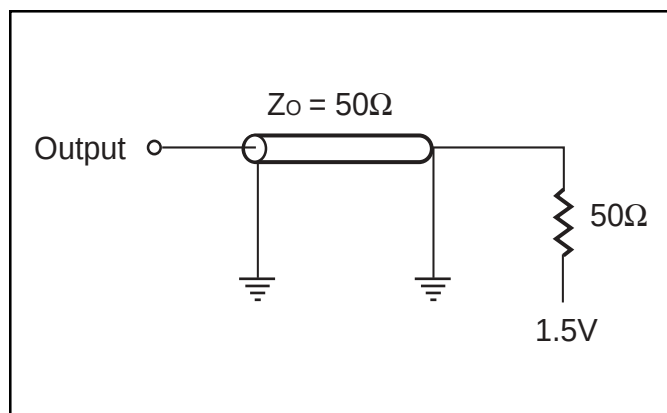


Figure 1

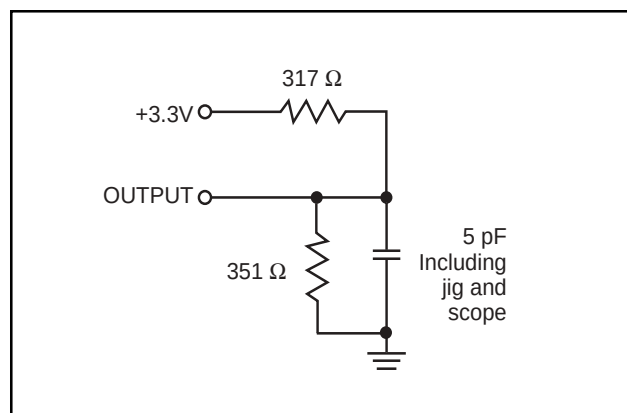


Figure 2

2.5V I/O AC TEST CONDITIONS

Parameter	Unit
Input Pulse Level	0V to 2.5V
Input Rise and Fall Times	1ns
Input and Output Timing and Reference Level	1.25V
Output Load	See Figures 3 and 4

2.5V I/O OUTPUT LOAD EQUIVALENT

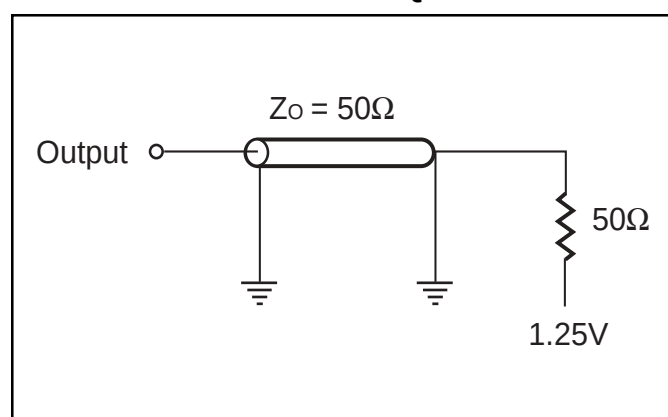


Figure 3

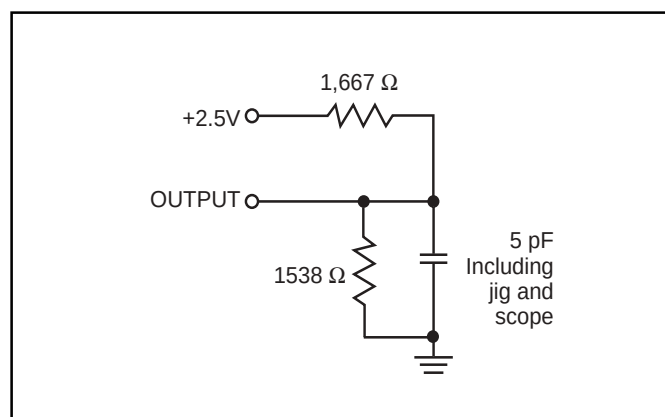


Figure 4

READ/WRITE CYCLE SWITCHING CHARACTERISTICS (Over Operating Range)

Symbol	Parameter	8.5		10		Unit
		Min.	Max.	Min.	Max.	
f _{MAX} ⁽³⁾	Clock Frequency	—	90	—	66	MHz
t _{CC} ⁽³⁾	Cycle Time	11	—	15	—	ns
t _{KH}	Clock High Time	4.5	—	4.5	—	ns
t _{KL} ⁽³⁾	Clock Low Time	4.5	—	4.5	—	ns
t _{KQ} ⁽³⁾	Clock Access Time	—	8.5	—	10	ns
t _{KQX} ⁽¹⁾	Clock High to Output Invalid	2	—	2	—	ns
t _{QQLZ} ^(1,2)	Clock High to Output Low-Z	0	—	0	—	ns
t _{QHZ} ^(1,2)	Clock High to Output High-Z	2	3.5	2	3.5	ns
t _{OEQ} ⁽³⁾	Output Enable to Output Valid	—	4.0	—	4.0	ns
t _{OELZ} ^(1,2)	Output Enable to Output Low-Z	0	—	0	—	ns
t _{OEHZ} ^(1,2)	Output Disable to Output High-Z	—	5.0	—	5.0	ns
t _{AS} ⁽³⁾	Address Setup Time	2	—	2	—	ns
t _{SS} ⁽³⁾	Address Status Setup Time	2	—	2	—	ns
t _{WS} ⁽³⁾	Write Setup Time	2	—	2	—	ns
t _{CES} ⁽³⁾	Chip Enable Setup Time	2	—	2	—	ns
t _{AVS} ⁽³⁾	Address Advance Setup Time	2	—	2	—	ns
t _{AH} ⁽³⁾	Address Hold Time	1	—	1	—	ns
t _{SH} ⁽³⁾	Address Status Hold Time	0.5	—	0.5	—	ns
t _{WH} ⁽³⁾	Write Hold Time	0.5	—	0.5	—	ns
t _{CEH} ⁽³⁾	Chip Enable Hold Time	0.5	—	0.5	—	ns
t _{AVH} ⁽³⁾	Address Advance Hold Time	0.5	—	0.5	—	ns

Notes:

1. Guaranteed but not 100% tested. This parameter is periodically sampled.
2. Tested with load in Figure 2.
3. Tested with load in Figure 1.

WRITE CYCLE SWITCHING CHARACTERISTICS (Over Operating Range)

Symbol	Parameter	8.5		10		Unit
		Min.	Max.	Min.	Max.	
t _{CC} ⁽¹⁾	Cycle Time	11	—	15	—	ns
t _{KH} ⁽¹⁾	Clock High Time	4.5	—	4.5	—	ns
t _{KL} ⁽¹⁾	Clock Low Time	4.5	—	4.5	—	ns
t _{AS} ⁽¹⁾	Address Setup Time	2	—	2	—	ns
t _{SS} ⁽¹⁾	Address Status Setup Time	2	—	2	—	ns
t _{WS} ⁽¹⁾	Write Setup Time	2	—	2	—	ns
t _{DS} ⁽¹⁾	Data In Setup Time	3	—	3	—	ns
t _{CES} ⁽¹⁾	Chip Enable Setup Time	2	—	2	—	ns
t _{AVS} ⁽¹⁾	Address Advance Setup Time	2	—	2	—	ns
t _{AH} ⁽¹⁾	Address Hold Time	1	—	1	—	ns
t _{SH} ⁽¹⁾	Address Status Hold Time	0.5	—	0.5	—	ns
t _{DH} ⁽¹⁾	Data In Hold Time	1	—	1	—	ns
t _{WH} ⁽¹⁾	Write Hold Time	0.5	—	0.5	—	ns
t _{CEH} ⁽¹⁾	Chip Enable Hold Time	0.5	—	0.5	—	ns
t _{AVH} ⁽¹⁾	Address Advance Hold Time	0.5	—	0.5	—	ns

Notes:

1. Tested with load in Figure 1.

The timing diagram for the ADSP1000 shows the following signals and their timing relationships:

- CLK**: Clock signal with period t_{KC} . Setup time t_{SS} and hold time t_{SH} are shown relative to $\overline{ADSP}$.
- $\overline{ADSP}$** : Address Strobe. Setup time t_{SS} , hold time t_{SH} , and clock-to-output delay t_{KL} are shown. A note indicates $\overline{ADSP}$ is blocked by $\overline{CE}$ inactive.
- $\overline{ADSC}$** : Address Strobe Clock. A note indicates $\overline{ADSC}$ initiates Write.
- $\overline{ADV}$** : Address Valid. Setup time t_{AVS} and hold time t_{AVH} are shown. A note indicates $\overline{ADV}$ must be inactive for $\overline{ADSP}$ Write.
- A**: Address. Setup time t_{AS} and hold time t_{AH} are shown. Data is written in bursts labeled WR1, WR2, and WR3.
- $\overline{GW}$** : Gate Write. Setup time t_{WS} and hold time t_{WH} are shown.
- $\overline{BWE}$** : Burst Write Enable. Setup time t_{WS} and hold time t_{WH} are shown.
- $\overline{BW4-BW1}$** : Burst Write Enable. Setup time t_{WS} and hold time t_{WH} are shown. Data is written in bursts labeled WR1, WR2, and WR3.
- $\overline{CE}$** : Chip Enable. Setup time t_{CES} and hold time t_{CEH} are shown. A note indicates $\overline{CE}$ masks $\overline{ADSP}$.
- $\overline{CE2}$** : Chip Enable 2. Setup time t_{CES} and hold time t_{CEH} are shown. A note indicates $\overline{CE2}$ and $\overline{CE2}$ only are sampled with $\overline{ADSP}$ or $\overline{ADSC}$.
- $\overline{CE2}$** : Chip Enable 2. Setup time t_{CES} and hold time t_{CEH} are shown. A note indicates Unselected with $\overline{CE2}$.
- $\overline{OE}$** : Output Enable. Setup time t_{DS} and hold time t_{DH} are shown.
- DATAOUT**: Data Output. High-Z state is shown.
- DATAIN**: Data Input. High-Z state is shown. Data is written in bursts labeled 1a, 2a, 2b, 2c, 2d, and 3a. A note indicates $\overline{BW4-BW1}$ only are applied to first cycle of WR2.

The diagram is divided into four main sections: Single Write, Burst Write, Write, and Unselected.

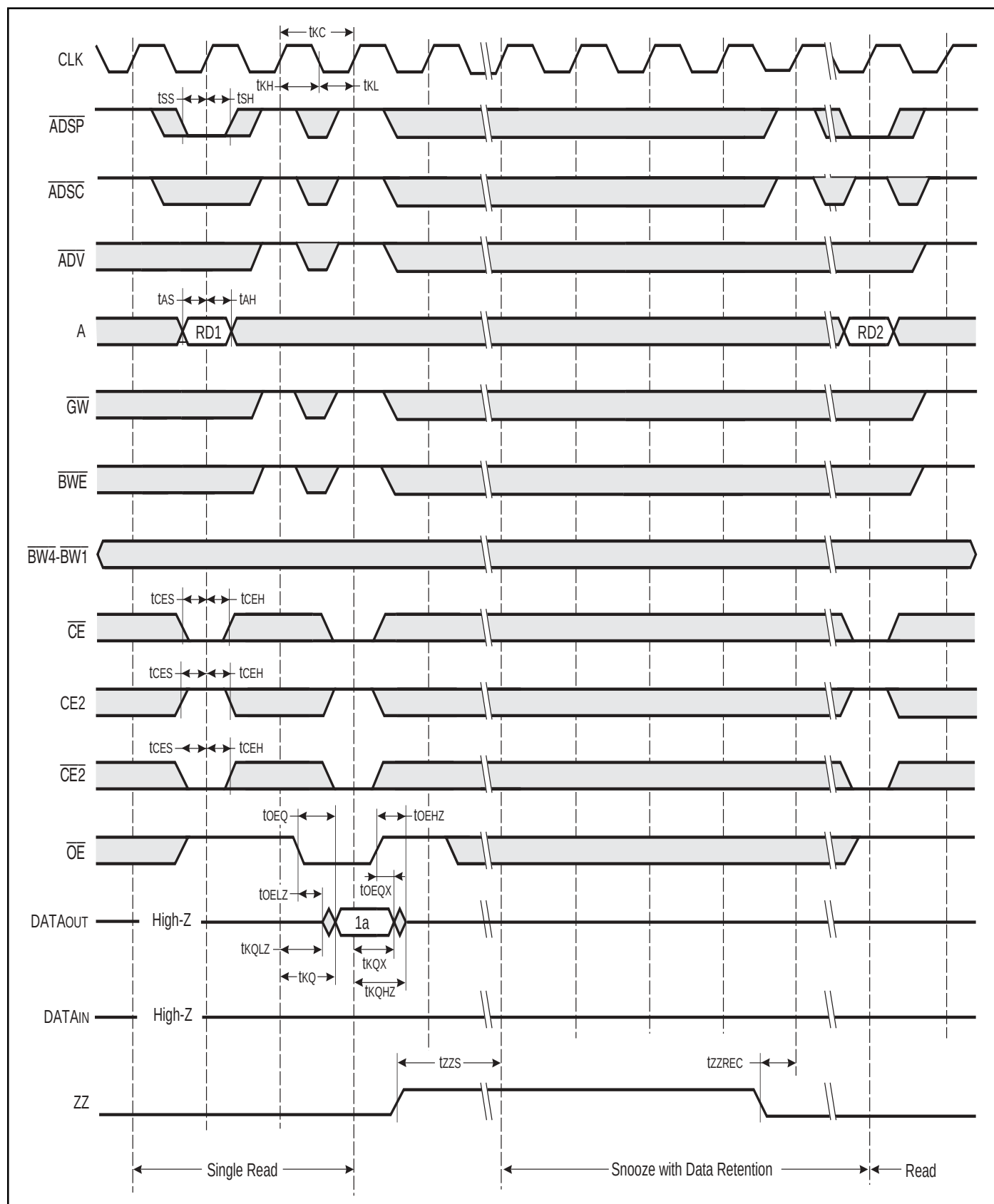
SNOOZE AND RECOVERY CYCLE SWITCHING CHARACTERISTICS (Over Operating Range)

Symbol	Parameter	8.5		10		Unit
		Min.	Max.	Min.	Max.	
t _{κC} ⁽³⁾	Cycle Time	11	—	15	—	ns
t _{κH} ⁽³⁾	Clock High Time	4.5	—	4.5	—	ns
t _{κL} ⁽³⁾	Clock Low Time	4.5	—	4.5	—	ns
t _{κQ} ⁽³⁾	Clock Access Time	—	8.5	—	10	ns
t _{κQX} ⁽¹⁾	Clock High to Output Invalid	2	—	2	—	ns
t _{κQLZ} ^(1,2)	Clock High to Output Low-Z	0	—	0	—	ns
t _{κQHZ} ^(1,2)	Clock High to Output High-Z	2	3.5	2	3.5	ns
t _{OEQ} ⁽³⁾	Output Enable to Output Valid	—	4.0	—	4.0	ns
t _{OELZ} ^(1,2)	Output Enable to Output Low-Z	0	—	0	—	ns
t _{OEHZ} ^(1,2)	Output Disable to Output High-Z	—	5.0	—	5.0	ns
t _{AS} ⁽³⁾	Address Setup Time	2	—	2	—	ns
t _{SS} ⁽³⁾	Address Status Setup Time	2	—	2	—	ns
t _{CES} ⁽³⁾	Chip Enable Setup Time	2	—	2	—	ns
t _{AH} ⁽³⁾	Address Hold Time	1.0	—	1.0	—	ns
t _{SH} ⁽³⁾	Address Status Hold Time	0.5	—	0.5	—	ns
t _{CEH} ⁽³⁾	Chip Enable Hold Time	0.5	—	0.5	—	ns
t _{ZZS}	ZZ Standby	2	—	2	—	cyc
t _{ZZREC}	ZZ Recovery	2	—	2	—	cyc

Notes:

1. Guaranteed but not 100% tested. This parameter is periodically sampled.
2. Tested with load in Figure 2.
3. Tested with load in Figure 1.

SNOOZE AND RECOVERY CYCLE TIMING



ORDERING INFORMATION (IS61LF6432A, IS61LF6436A)

3.3V I/O OR 2.5V I/O

Industrial Range: -40°C TO +85°C

Speed (ns)	Order Part No.	Package
8.5	IS61LF6432A-8.5TQI	TQFP
8.5	IS61LF6436A-8.5TQI	TQFP

ORDERING INFORMATION (IS64LF6432, IS64LF6436)

3.3V I/O OR 2.5V I/O

Temperature Range (A2): -40°C to +105°C

Speed (ns)	Order Part No.	Package
8.5	IS64LF6432-8.5TQA2	TQFP
8.5	IS64LF6436-8.5TQA2	TQFP

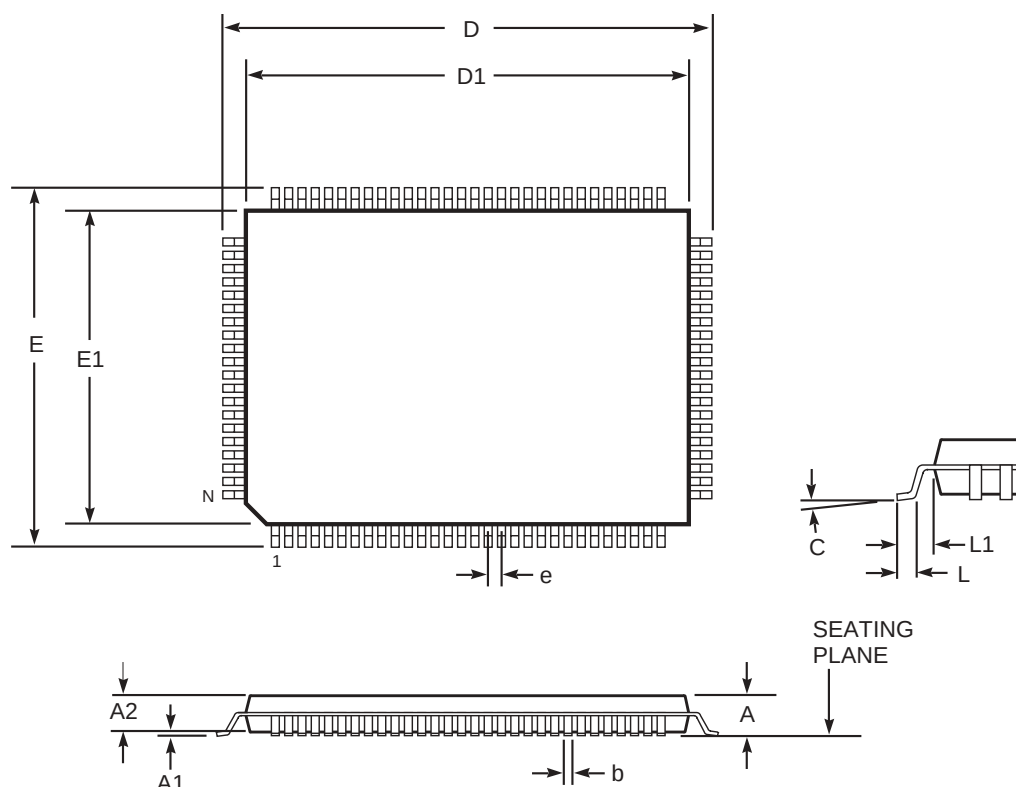
Temperature Range (A3): -40°C to +125°C

Speed (ns)	Order Part No.	Package
10	IS64LF6432-10TQA3	TQFP
10	IS64LF6436-10TQA3	TQFP

PACKAGING INFORMATION

TQFP (Thin Quad Flat Pack Package)

Package Code: TQ



Thin Quad Flat Pack (TQ)								
Symbol	Millimeters		Inches		Millimeters		Inches	
	Min	Max	Min	Max	Min	Max	Min	Max
Ref. Std.								
No. Leads (N) 100					128			
A	—	1.60	—	0.063	—	1.60	—	0.063
A1	0.05	0.15	0.002	0.006	0.05	0.15	0.002	0.006
A2	1.35	1.45	0.053	0.057	1.35	1.45	0.053	0.057
b	0.22	0.38	0.009	0.015	0.17	0.27	0.007	0.011
D	21.90	22.10	0.862	0.870	21.80	22.20	0.858	0.874
D1	19.90	20.10	0.783	0.791	19.90	20.10	0.783	0.791
E	15.90	16.10	0.626	0.634	15.80	16.20	0.622	0.638
E1	13.90	14.10	0.547	0.555	13.90	14.10	0.547	0.555
e	0.65 BSC		0.026 BSC		0.50 BSC		0.020 BSC	
L	0.45	0.75	0.018	0.030	0.45	0.75	0.018	0.030
L1	1.00 REF.		0.039 REF.		1.00 REF.		0.039 REF.	
C	0°	7°	0°	7°	0°	7°	0°	7°

Notes:

1. All dimensioning and tolerancing conforms to ANSI Y14.5M-1982.
2. Dimensions D1 and E1 do not include mold protrusions. Allowable protrusion is 0.25 mm per side. D1 and E1 do include mold mismatch and are determined at datum plane -H-.
3. Controlling dimension: millimeters.